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SKILL

SUMMARY

Two groups of investigators of the relation of the workers to their work, 626. — Both fail to emphasize certain subtle factors of shop lore, 627. — Individual makers of "whole articles" never as common as is sometimes assumed, 627. — In the few authentic cases the work was not especially inspiring, 627. — Nail making, 628. — Pottery, 628. — Current use of the words "skilled," "semi-skilled," and "laborers," 631. — Importance of ability to prejudge effects of processes, 632. — Knowledge of qualities and conditions of materials, 632. — Knowledge of preceding operations, 633. — Ability to manipulate large pieces, 634. — On minor jobs there are many situations that require adjustments and judgment, 635. — The casual onlooker seldom appreciates the skill required in apparently simple operations, 636. — Accurate analysis and description of operations needed, 639. — Entrepreneurs found early craftsmen no more ready to meet their problems than does the modern business man, 642. — Problem of building up an organization largely one of training workers, 643.

A GENERAL article on the subject of skill would have no place at this time were it not for two wholly different group investigators, each group bringing its findings to bear upon modern industry. There is, first, a group of careful scholars interested in securing better occupational descriptions. For the time being emphasis is laid by them primarily upon the actual operations performed. Only after better specifications are secured for the work itself is consideration given to the personal qualities of the worker, such as intelligence and judgment.

The second group of students hope, by going into industry, to describe in terms of first-hand experience the effect of shop work upon the worker. Each group has felt it necessary to see a large number of jobs and industries under varying conditions. Obviously, there is much to be said for finding out what has made for success in persons engaged in particular occupations. The investigator must guard, however, against explaining too much by the particular bias which brings him to the problem.

It is because both groups are failing to emphasize some of the more subtle factors of shop lore and shop experience that I have attempted to point out some aspects of "skill" easily overlooked.

The discussion of the effect of shop work is by no means new. Since the time of Sismondi there has been much in non-technical literature concerning the disappearance of skill in manufacture. The statement is made that the division of labor has broken up occupations until one can no longer find the interest or skill possessed by a workman who made the whole finished article. Still more frequent is the statement that the skilled trades tend to deteriorate into a series of mechanical processes any one of which can be learned in a short time. In other words the workman is pictured as useful merely to remain on guard to start and stop machines.

Going back to the records of the early period, with the exception of a handful of custom trades, some articles of ornament, and the products of a few industries in scattered areas, it is difficult to unearth many really interesting articles made and finished wholly by the same workman. Even then, while we are quoting the "whole shoe," (and I have looked vigorously and faithfully for a range of similar illustrations), we must bear in mind that all "whole articles" were not as exceptional in themselves as the whole shoe. There were nail makers, and harness buckle makers, and any number of makers of none too interesting "whole" articles.

Here is an account of the hand processes in nail making which will illustrate its minutae: "The rapidity with which nails may be made is illustrated by the fact that in two weeks a workman made 40,800 flooring 'clasps' each of which was struck by a hammer weighing 2 pounds twenty-five times, including the welding together of pieces of nail rods which had become too short to work. The number of blows struck amounted to 1,033,655; the rods were heated 43,836 times; a good example of rapidity, skill and minuteness." [1] The nail industry will serve as well as any to illustrate the type of labor which is not made interesting by the mere fact of the product being the entire article. We must bear in mind, too, that when one tries to build up the whole family of screws, and bolts and knobs, and wedges, that this class of article always bulked large in the total manufacture.

On the other hand, wherever we have early records of the details of the shop, there seems to be little doubt that men specialized considerably. Many illustrations might be given, I take but one. In the potteries, in the time of Josiah Wedgwood, there was no assumption that men could do every operation. Wedgwood writes that he had not a man in his shop who could make a *whole table plate.* If one had not his positive statement on the subject, this record of his account books would indicate that hiring was done with special jobs in mind. The following is from Wedgwood's account book as published by Jewitt.[2]

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[1] W. C. Aiken, in Birmingham Manufacturing Industries, vol. iii, p. 32.

[2] Llewellynn Jewitt, Life of Josiah Wedgwood, pp. 113–115.

1749.		£	*s.*	*d.*
Jany. 27.	Hired Jno. Austin for placeing white, &c. pr. week	0	5	6
Feb. 16.	Hired Wm. Keeling for handleing	0	6	0
Feb. 20.	Hired Wm. Cope for handleing & vineing cast ware, for	0	7	0
March 8.	Then hired Jno. Barker fr ye huvels @	0	5	6
March 24.	Hired —— Low for making Slip	0	5	3
March 26.	Then hired George Bagnall, for fireing for this year, for	0	5	3
June 2.	Hired a boy of Ann Blowrs for Treading ye lathe, per week	0	2	0
1751.	Then hired Elijah Simpson for Turning, he is to have pr week.	0	8	0
Jany. 11.	Then hired Saml. Jackson for Throwing[3] Sagers and fireing, pr week	0	8	0

Wm. Keeling spent his days putting handles on crocks, pitchers, and cups. He probably worked apart in a shed, as was usual in his time. Elijah Simpson worked at the lathe, which had been adapted in his own time to the uses of pottery. And when work was in the kiln Samuel Jackson had a keen enough eye for proportioning to be able to fill out the time forming at the wheel. Josiah himself would probably have had difficulty in getting away from the potter's wheel had it not been for the illness which paralyzed his leg.

Even when the worker can plan and produce the whole article, it must be borne in mind that cases of striking originality are not common. We have surprisingly few models of chairs evolved in the period of cabinet making. The model of a Chippendale, a Sheraton or a Heppelwhite dominated a whole period and can be found influencing the models of every country from China to British Columbia. Marshall brings out clearly the element of imitation in cabinet work. He says, "But it seems that there is very little truth in the opinion that all furniture, which has been made by hand, has shown traces of the individuality of the craftsman. Some of it did: and because it was good, it was defended from rough wear, and has come down to us almost unharmed. But in places where nearly all furniture is made by hand, there is much monotonous weary work, without interest or initiative. Thus a visitor to the Grödener Tal, in Tyrol, may find a nest of artists whose wooden statuary is sought for the adornment of cathedrals far and wide; and he may come across a peasant, with hard hands, who loves hay making more than his winter work at wood carving, tho that is of high artistic excellence. But he may also find in the same neighborhood people who carve toys by the cartload, many of which are crude, ill-shaped reproductions of a pattern that has been set to them. An inquiry as to such a load evoked the answer: 'Before our father died, he taught us to make horses like this, and we cannot venture on anything new.' The horses' necks were all bent in the same impossible and ugly curve." [4] The person who undertakes to work out for us the social effect of the machine should not present a sentimental picture of an interested artisan group, original, inventive, and discriminating. In order to be suitable to machine technique there must have been operations requiring less discretion than others. Added to this, processes often were heavy, weary and repetitive. By isolating such operations and applying machinery to the work it was necessarily the operations with least variety which were eliminated first from hand work.

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[3] Note: Jewitt—"A 'thrower' is the man who forms at the 'potter's wheel' the vessel by hand from the moist clay. The 'ball' of clay being placed on the disc, the boy, or girl, employed for the purpose, turns the wheel quickly or slowly as occasion requires. By this means the disc is made to rotate horizontally and the 'thrower,' who is seated, forms the vessel by hand and by the aid of guides for shape which he has prepared for the purpose. The throwing, it will thus be seen, is the first and most important operation in the forming of the vessels."

If there is a fundamental distinction regarding the method of working it would seem to be found, not in whether the worker makes the whole of the article or a part of the article, but in whether the work is such that "the complete design can be gradually evolved as the work proceeds." Fortunately, for the producer, most manufactured articles can be made from drawings. Every detailed measurement of the article can be worked out. Besides the drawing is as intelligible to the mechanic as would be the machine itself. We must, therefore, look for the problem of skill where the product or part constructed depends upon the certainty of the methods used rather than upon the origination of the actual design.

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[4] Alfred Marshall, Industry and Trade, p. 808, note.

Considering the glibness with which workmen are pigeonholed as "skilled" "semi-skilled" and "laborers" in many industries, it is surprising to find little definition of what constitutes skill, or lack of skill. Every one takes it for granted that precisely what he means is understood by referring to a workman as possessed of "skill." We still rate as of the highest skill those occupations which existed as trades before the modern factory era. No doubt some of the traditional gradations into skilled and less skilled occupations mean merely that the past lives on, despite the fact that the actual conditions which made the difference have long since faded from practice. More precise, in this particular, is the language of the shop. There is growing up a long list of classified occupations, more or less definite in meaning, from one concern to another. Old terms, too, are tending to be modified. In a time when machine tools were more widely made in each plant, a tool maker was graded as the highest rank metal worker. Now "tool maker" is coming to be regarded as a general term, and a die maker describes a workman of unusual accuracy, precision, and fineness of judgment in metal work.

A long list of exceedingly complex factors are covered up by the lack of analysis of the term skill. Perhaps the most difficult phase of skill to comprehend is the knowledge and ability necessary not only to judge effects, after they have been produced, but to foreknow them. Frank J. Becvar gives an illustration of this kind in the clothing industry. "In hand pressing, the operative must be able not only to recognize the quality of the effect he has produced, but to prejudge this effect on each kind or texture of cloth and thereby know how to treat it." [5] In more general terms Nasmyth writes: "The grand result of thoughtful practice is what we call experience. It is the power or faculty of seeing clearly, before you begin, what to avoid and what to select." [6] In the weaving of the pattern, the designer must know not only that one pattern will be suitable for one class of cloth and unsuitable for another, but he must distinguish in advance between patterns which could be put on fine cloth, but could under no circumstances be suitable for a coarse fabric. While, therefore, to design a pattern a very slight knowledge of materials would seem requisite, actually a knowledge of the technicalities of materials is really necessary.

In a like way knowledge of the effect of change in temperature or atmosphere is necessary. In many industries atmospheric changes affect every operation. In the silk industry whether the operation be winding, knitting, or weaving, a change in moisture affects the breakage so seriously that only the most experienced workers are able to continue effective operation. Less marked, but with equally troublesome problems for the operator are the changes in paper caused by moisture. Nor is it easy to teach one exactly how to control such factors. In the plating industry, in cold weather, trouble is experienced with most solutions because of the crystallization of the salts. To the layman it might seem that the effect of this variation would be felt only in the rooms where the solution was used. Actually the slightest variation affects both machine and hand burnishing, since the irregularity of hardness makes finishing with a burnishing tool very difficult.

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[5] Frank J. Becvar, "A Method of Grading and Valuing Operations," Annals, March, 1922, p. 16.

[6] James Nasmyth, An Autobiography, edited by Smiles, p. 148.

Some operations require a knowledge of preceding operations. Even in the much discussed automobile assembly where men work in groups, each performing a separate operation, an assembling foreman writes: "If at any time one of the operators gets into trouble with his operations, the other men help him out until the trouble has been killed, thus preventing a delay to the job as a whole." Thus automobile assemblers know something of each other's jobs. One wonders whether the change in machine assembly has been as marked in the direction of less interest in work as it has been in the direction of less annoyance. "Before his (Maudsley's) time no system had been followed in proportioning the number of threads of screws to their diameter. Every bolt and nut was thus a specialty in itself, and neither possessed nor admitted of any community with its neighbors. To such an extent had this practice been carried that all bolts and their corresponding nuts had to be specially marked as belonging to each other. Any intermixture that occurred between them led to endless trouble and expense, as well as inefficiency and confusion, especially when parts of complex machines had to be taken to pieces for repairs. None but those who lived in the comparatively early days of machine manufacture can form an adequate idea of the annoyance, delay and cost of this utter want of system, or can appreciate the vast services rendered to mechanical engineering by Mr. Maudsley, who was the first to introduce the practical measure necessary for its remedy."[7] Again the operation may involve general knowledge of materials, or speeds, or tools. Besides this general knowledge, some work involves the making of many independent decisions such as are necessary in tool work or die making. In tool making the extreme accuracy necessary to do the work successfully is, of course, an important factor. Even when extreme accuracy is not required there is among workmen a persistent estimating of bench work as more skilled than machine work, a belief which is somewhat accounted for by the responsibility felt in making a large number of independent decisions. The rules which guide in such decisions are uncodified. A woodworker will discard board after board until he finds one suited to his purpose. The explanation he would give might be very inadequate to account for the selection and yet there would be an ungeneralized impression among wood workers that no amount of telling would lead an inexperienced person to any sureness of an equally adequate choice.

In addition to responsibility for decisions the actual variety of operations performed is important. Pocket making is considered to be a very skilled operation. "The operative must know how to put in all kinds of pockets — flap, horizontal welt, vertical welt with inlaid facing, crescent shaped pockets, piped edges, patch pockets and the like."[8] "Out and out" work in box making is considered highly skilled tho it is made up of a series of operations no one of which is especially high grade.

Ability to manipulate large pieces often puts the worker in a class by himself. In the making of porcelain vases in Japan Toichi outranks others. He was considered an exceptionally skillful workman. He was said to be the only potter who could fashion the largest vases without the help of machinery. The Westinghouse Company regards work done on a large product as of higher grade than similar work on small parts. Thus men on engine lathes fall into different classes according to the product worked upon. This is a recognition of the value of the product which may be impaired by lack of care. The same consideration, accompanied by some customary recognition of prestige, accounts for paying a higher rate for seaming on high-grade blouses than for the same work on low-grade blouses. An interesting case of the recognition of the value of the product impaired occurs in the supervisory force of mechanical dental laboratories. "The head of the plaster bench earns less than a supervising rubber worker, and the latter earns less than the head of the gold workers." [9]

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[7] James Nasmyth, An Autobiography, edited by Smiles, pp. 131–132.

[8] Becvar, "A Method of Grading and Valuing Operations," Annals, March, 1922, p. 16.

Is it necessary to continue this list, adding work where special manual deftness is important or to cite the much longer list of small work where extreme accuracy is required? The elements already considered are not intended to be exhaustive. In fact, the listing is undertaken mainly to show that on apparently simple jobs there are many situations to meet involving adjustments and judgments. On minor operations more "skill" is required than is currently assumed. Any plant can initiate a certain number of novices on many of its operations. There is, however, a limit to the number who can be initiated at any one time. A room full of operatives of so-called automatic machines without a generous sprinkling of older operatives would be impossible to supervise. On many operations said to be learned in one or two weeks inquiry elicits the fact that with a longer period the worker becomes considerably more valuable. He learns to meet new situations which arise from time to time. He learns more about the materials, and finally, he has set up for himself danger signals which help him to anticipate many of the difficulties.

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[9] Ruth Woodruff, "The Dental Laboratory, Mechanical Work and Training." Unpublished report.

It is not an accident that attention to foreman training came in the war period when crowds of new workmen had to be initiated into shops in a short time. Many of our most serious delays in production came not on the highest grade work but in places where the management attempted to use untrained men.

During the war we had a chance to act upon the theory that it takes little training or skill to do minor jobs; that in a few hours a new employee is as good as an old one. What happened? Only the foreman and production supervisors can really appreciate what was the task of oversight. Older workers would have met some situations themselves; other difficulties would have been anticipated; while still more problems would never have arisen. In peace time the proportion of inspectors and supervisors to operators is actually not great; showing again the observation and attention given by men on detail work, as production advances through the shop. By contrast recall the crowds of inspectors in plants during the war. Increase in inspectors was not confined to munitions plants but was part of the whole war problem of costs. Much of this inspection was made necessary by the fact that operations normally controlled by experienced men on minor jobs produced parts that had to be detected after many other defective pieces had been run off by a new operator.

The tendency of a man who knows the work is to upgrade apparently simple tasks. Nasmyth recognized the demands made upon workmen in moving machinery. His commendation would be echoed by every shopman who has had to supervise such work. He says: "The village of Worsley, the headquarters of the Bridgewater Canal, supplied us with a valuable set of workmen. They were, in the first place, laborers; but like all Lancashire men, they were naturally possessed of a quick aptitude for mechanical occupations connected with machinery. Our chief employment of these so-called laborers was in transporting heavy casting and parts of machinery from one place to another. To do this properly required great care and judgment, in order that the parts might not be disturbed, and that the workmen might proceed towards their completion without any unnecessary delay. None but those who have had practical acquaintance with the importance of having skillful laborers to perform these apparently humble but in reality very important functions, can form an adequate idea of the value of such services." [1]

Going to the shop for a short time one can easily overlook factors which would become important in a longer experience. Frequently a machine process can be learned in a short time. To an onlooker the running of the machines constitutes the job but an expert would take that for granted and be interested in some of the situations where it is possible to show the acquisition of fairly accurate judgment. Some of these factors become apparent whenever one attempts to actually find trade tests which will differentiate expert workmen from others less capable. Frequently the test really appears to be outside the actual job. For instance, the best inside lineman's test in the army — that which really differentiated workmen — was an outside wireman's job. The fact is that a really good inside wireman does know something of outside wiring.

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[1] **James Nasmyth, An Autobiography, edited by Smiles, pp. 216, 217.**

We have swung quite far enough in depreciation of the "skill" of machine operators. Much of the swing is due to the fact that when one person uses the term "skill" he means variety of processes whereas another means knowledge of the capabilities of materials or expertness in tooling or chasing. If the issue were made definite every one would agree that "Modern work is more narrowly specialized, in so far as the number and variety of the operations performed by a modern worker are on the average less than those of the elementary skilled handicraftsman: but it is less narrowly specialized, in the sense that an operative, who has mastered the accurate, delicate and prompt control of machinery of any kind in one industry, can now often pass, without great loss of efficiency, to the control of similar machinery in an industry of a wholly different kind, and perhaps working on different material."[2]

I am not attempting to discuss the problem of monotony or interest in work. What I am concerned in showing is that every decade has been one of change in the particular elements which made for skill. When the early carpenter spent much time with a saw ripping the parts he needed from heavy boards, he might have been a better sawyer than when he spent his time fitting panels or trimming moldings. In a period when there was nothing to guide the pressure of a tool on the piece of metal the slightest variation made an irregularity of surface that had to be touched up, and fitted by filing. In such a time an old workman might well describe another as being "*quite splendid* with an eighteen inch file." What was fine in the workmanship of this period should be appreciated. I have no desire to underrate the accomplishments of early production. Even then, however, every workman was not a "best" workman. We hear much in these days of the workmen who cannot make their own "set up." Does any one think that every weaver in the household period was able to set up her own web in the loom? If so, he has read his history badly. Gaps in "skill" were filled in by the spirit of neighborliness and a half dozen looms in a half dozen cottages waited for the visit of a specially intelligent neighbor to help pick up the puzzling threads that arranged the pattern in the hedles. The same spirit of neighborliness, now, prompts workers to keep an eye on the new comer. A hint here, and an explanation there, helps tide over a learning period which is difficult for both worker and foreman.

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[2] Alfred Marshall, Industry and Trade, p. 10.

This brings us to the phase of shop work least appreciated. It is comparatively easy to learn to operate a machine. Much more subtle is the knowledge and control of the materials of trade. While we have really made headway in the standardization of certain processes, much remains for research in the field of raw materials. Still more detailed should be the study of the control of these materials at different stages of manufacture. There is here a real problem which should command the best thought of the many students who are now fooling themselves into thinking that they are passing as real workers in industry. To contribute anything valuable one would have to stay in an industry long enough to experience some of the later stages in learning, instead of the first thrills of a new environment. It would be a measurable contribution if we could get some really thoro first-hand observing by persons capable of describing problems as well as the routine of processes. One who has come from the shop goes wearily through the present writings on the subject describing, in a purely mechanical way, processes of the utmost importance. From reading the following who would know that one of the most important processes in the box industry is being described.

> The operator has but to place the box in the center of the freshly glued wrap supplied to her on a rotating table by the gluer-off and place the box and wrap on the form the exact size of the box. This form drops automatically, passing brushes and rolls that press the wrap to the box, folding it at the corners and turning in the paper projecting at the top. Then the box is pushed out of the machine and the form rises to receive another box and wrap.

Contrast with this the keenness of perception and the appreciation of the interrelation of manufacturing processes in this description from one who went to the shop thinking in terms of the problem instead of in terms of herself.

> One of the last operations in the making of a rubber shoe is the placing of the "upper" over the lining of the shoe. This piece of rubber is not vulcanized and its condition may vary greatly, according to the experience and judgment of the man who runs the stock in the mill room. If the calender man lets his rolls get too warm, the rubber stock is likely to be sticky. If the day is cold, or if the stock was prepared one or two days sooner than usual, the rubber will be too dry to adhere to the lining, and will form blisters when vulcanized. Very quickly, the maker, in opening her book of uppers, will learn how to use her judgment in handling them. If she feels them too "sticky," the deftness of her fingers and the rapidity and preciseness of her movements will prevent the material from forming folds which would destroy the quality of the shoe. If she sees that the rubber stock is too dry, she knows that a small amount of cement will make it adhere to the lining as it should. And it is likely that she will experience a feeling of satisfaction in mastering the whims of a piece of unvulcanized rubber.[3]

Real description of a modern industrial process should imply keeping the process in its setting. If one's task involves working with paper and glue on a delicate machine, some day there will be more to do than to primly

[3] France M. A. Chalufour, unpublished notes.

"place the box in the centre of the glued paper." In fact the forceful language of Giddings, in another connection, is not out of place here. "The laborers that have no adaptiveness, that bring no new ideas to their work, that have no suspicion of the next best thing to turn to in an emergency, might better be identified with the dependent classes than with the wealth creators." [4] It is strange to find persons who go to industry with an honest intention of understanding the worker, actually describing the shop with about as much comprehension of what is involved in production processes as the summer boarder carries away with regard to the problems of the farmer.

Modern industry involves a care and experience in the detail of processes very likely to be taken for granted. Often one can cite a key process, variation in which affects all others. Whole volumes could be written on the effect of the variations in the calendering process; or better still, on the different way in which these variations affect every worker in the whole series of rubber-finishing processes. In the metal industry, despite the great assistance of chemists, it would be impossible to secure steel so uniform in content and so even in hardness that there would not be at some point daily variations that would affect grinding and machining throughout the shop.

Further, if one considers the delicacy of adjustment of many machines doing minor processes there is too little outright admission of the importance of machine operations. Again when one recalls that we are working to much more precision of measurement than ever before, the wonder is that, despite the passing of the all-round man, so little is said of the amount of "skill," perhaps developed in a different way, which remains in our shops. Summarizing these, we conclude that it is not because the modern machinist cannot handle a file in the *quite splendid* way in which Maudsley manipulated it; it is not because he does not make his tools by hand; or even because he makes only part of the article that he can less effectively meet new situations. In so far as there is any truth in the much quoted passing of the general machinist the cause lies more in lack of knowledge of the materials of his trade.

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[4] Franklin H. Giddings, Studies in the Theory of Human Society, N. Y., 1922, p. 237.

In every occupation there is from time to time more or less evolution in the elements of the trade which would be emphasized. Often the change means the substitution of scientific methods for empirical. When this happens the "skill" to meet the variations due to former rule of thumb methods goes and its going is not to be deplored. In its place comes a specialized knowledge of the new development. Whenever industry thus steps forward the innovators must grapple with the problem of training up workers to suit their purpose. They draw upon the trades most closely allied. Some accumulated experience is thus supplied by the workmen. During the transition innumerable experiments conducted before the workers give them, in time, a code of practice to apply to the new situation. In this way the first technique of an organization grows up. Later workers will be trained by these earlier comers without the stage of experimentation and despite later changes in technique the atmosphere of the shop continues. Entrepreneurs found early craftsmen no more ready to meet their problems than does the modern business man. Watt was in despair with the "villainous bad workmanship" of the smiths of Glasgow. Wedgwood was "teased out of" his life by workers unsuited to his problem. He wrote: "We have stepped forward before the other manufacturers, and we must strive to train up hands to suit our purpose. Where, among our potters, could I get a complete vase maker? Nay I could not get a hand through the whole pottery to make a table-plate without training him up for that purpose; and you must be content to train up such painters as offer, and not turn them adrift because they cannot immediately form their hands to our new style, which, if we consider what they have been doing all their life, we ought not to expect from them." [5]

This problem of building up an organization was recognized long ago by manufacturers. In 1825, John Martineau, testifying before the Committee of the British House of Commons, said, "there would be less difficulty in increasing an establishment already existing than there would be in the formation of a new concern; in my case I should draft off some of my superior workmen to the new establishment and fill vacancies with new men." [6] Altho modern industry is far more concerned with the building of a smooth working organization than were the early enterprisers, among employers only slowly has there grown up the impression that it takes years to build up an industrial organization. Even now, no one specifies, what are the mysterious factors in the building. As already stated, each decade has seen changes in the factors most prized in a journeyman. The work of Bentley, Watt, Brunel, and Maudsley trained up a new group of mechanics, supplied with better tools and fitted for more accurate work than could be procured through the old whitesmiths and blacksmiths. By the time of Clement ability to draw was the hiring passport. We have still further specialized draftsmanship.

While this evolution in skill has gone on in our shops our thinking has lagged a half a century behind in appreciation. We have harked back to the small shop and the whole article.[7]

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[5] Samuel Smiles, Josiah Wedgwood, p. 167.

[6] British Parliamentary Papers, 1840, vol. 24, p. 20.

What I have intended to stress is the need of evaluating our present problem in terms other than those of the *journeyman-apprentice* days which have passed and have taken with them much heavy, weary work as well as much tedious fitting, filing and laborious drilling. In its place we have left some new work that is dreary. We have besides, much new work done with more delicate and more sensitive machinery. Because the machinery is sensitive we have given it much attention and thrust upon the workman the problem of using sensitive equipment with rather little attempt to standardize raw materials. The future will bring much correction in recognition of the importance and problems of machine jobs.

The problem of the manufacturer is to rate work in such a way as to prevent the loss of the actual contribution and control of the minor jobs. It is not an easy problem. It is a problem of ever changing factors and of ever more complex combinations. To appraise skill in terms of the small shop and the hand tools of a pre-factory age is to evaluate its most obvious and least significant aspects.

Attention has already been directed to the fact that one of the intangible elements of skill is experience in judging the effect of a process and in varying it to meet the factors that cannot be controlled. This conclusion involves a new approach to the question of job descriptions and interest in workmanship. We need "job specifications" made with imagination enough to include what the worker himself sees as the fine points and importance of the task which he performs. Technically we need specifications that take count of the variations in processes. We need specifications that picture the man in the organization, not on a desert island of perpetual motion.

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[7] "A man who could draw or work to a drawing in those days was regarded as a superior sort of mechanic." Samuel Smiles, Industrial Biography, Iron Workers and Tool Makers, 1879, p. 241.

A new conception of skill involves recognition of the continuously varying factors in the modern industrial relations problem — factors the evaluation of which will require the bringing together of the findings of science in many fields of study.

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